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REVIEW ARTICLE

Teaching professionalism in science courses: Anatomy to zoology

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Abstract Medical professionalism is reflected in attitudes, behaviors, character, and standards of practice. It is embodied by physicians who fulfill their duties to patients and uphold societies' trust in medicine. Professionalism requires familiarity with the ethical codes and standards established by international, governmental, institutional, or professional organizations. It also requires becoming aware of and responsive to societal controversies. Scientific uncertainty may be used to teach aspects of professionalism in science courses. Uncertainty about the science behind, and the health impacts of, climate change is one example explored herein that may be used to teach both professionalism and science. Many medical curricula provide students with information about professionalism and create opportunities for students to reflect upon and strengthen their individually evolving levels of professionalism. Faculties in basic sciences are rarely called upon to teach professionalism or deepen medical students understanding of professional standards, competencies, and ethical codes. However they have the knowledge and experience to develop goals, learning objectives, and topics relevant to professionalism within their own disciplines and medical curricula. Their dedication to, and passion for, science will support basic science faculties in designing innovative and effective approaches to teaching professionalism. This paper explores topics and formats that scientists may find useful in teaching professional attitudes, skills, and competencies in their medical curriculum. It highlights goals and learning objectives associated with teaching medical professionalism in the basic sciences.

Introduction

Medical professionalism can and should be taught to medical students in basic science courses so that students become knowledgeable about, and able to uphold and improve upon, standards of medical practice. Medical curricula often rely on faculties in bioethics, humanities, or

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clinical practice to teach professionalism but basic science faculties are also qualified to teach professionalism [1]. Scientists understand the contributions their disciplines make to medicine and society, and appreciate the value of science and scientific methods. Meaningful science requires integrity and professionalism, therefore, scientists should recognize the importance of teaching aspects of professionalism associated with their disciplines.

Professionalism

Professionalism in any discipline is reflected in attitudes, behaviors, character, and standards of practice. Standards are established through international, governmental, institutional, and professional organizations. Professionalism requires familiarity with ethical standards and codes that guide one's discipline, and commitment to upholding those codes and standards. Professionalism also requires awareness of, and ability to manage, conflicts between personal and professional values.

Once committed to exploring possibilities for teaching professionalism, scientists must distinguish between universal aspects of professionalism that apply to all disciplines, and those aspects that are uniquely relevant within their own discipline. They must identify which of these to prioritize in their own teaching and craft a related teaching goal and learning objectives. Scientists' dedication to and passion for their respective disciplines facilitates their design of learning objectives and course materials, their development of innovative and exciting formats, and their ability to teach professionalism enthusiastically within science courses.

Teaching professionalism involves helping students to develop professional competencies that strengthen their abilities to uphold their commitment to patient care and public trust [2]. Professional competencies are defined as cognitive (able to recognize gaps in one's own knowledge and learn from experience); integrative (able to cross reference and analyze information and manage uncertainty); relational (able to communicate effectively and maintain relationships); and moral (able to identify what is morally relevant in a situation and willing to acknowledge and correct errors) [2]. As a foundation for professional development, these competencies are useful in teaching students about attitudes, behaviors, and reasoning in science or medicine. This paper explores learning objectives, topics, and formats that scientists may find useful in teaching professional attitudes and competencies to medical students.

Goals and learning objectives

Medical curricula center on goals and objectives that are influenced in part by availability of institutional teaching resources. Goals for teaching professionalism must support both the institutional mission and the goals of the medical profession. The teaching goals, nature of the student body, availability of teaching resources, and scientists' own professional interests should guide development of professionalism learning objectives.

About 20% of my required first year bioethics course for medical students addresses professionalism but science courses may teach and promote professionalism using as little as 1% of course time and content. The impact can be significant, particularly if several courses in a given curriculum contribute a similar effort. To encourage basic science faculties to teach medical professionalism, institutions and administrators might offer incentives such as a financial bonus, release from other duties, or positive consideration during promotion or tenure decisions.

Some believe that students learn professionalism by observation or default. Teaching it effectively, however, requires that learning objectives be provided to students and their mastery of these be assessed. Some learning objectives associated with professionalism can be adapted to any course or discipline. For example "Name two sources of professional guidance for physicians" might be used to expose students to institutional or other guidelines relevant to a given discipline. The word "physicians" might be replaced with "medical students", "scientists" or "researchers" to direct students to different sorts of guidelines, many of which are electronically available.

An objective such as "Use electronic resources to obtain and critically assess information on cardiac arrhythmia" (or substitute another condition) might teach the associated science and lead students to develop library skills, knowledge about information technology and the diversity of information and sources, and to generate critical thought about reliability of information and sources. Students should learn that the broad marketing of medications and products for commercial profit may obscure scientific or clinical evidence about diagnostic tests or treatments.

Culture bears on how one communicates even scientific or medical information and on how others interpret that information. The objective "Explain the role of culture in the doctor—patient relationship" (or in any relationship of interest) will generate cultural sensitivity and awareness of bias. Attempts to explore cultural and other types of bias may model objectivity while teaching the related science and enhancing student understanding about the implications of sharing or interpreting data. Medical student culture differs from the culture of physicians, and culture differs between medical specialties, therefore, addressing culture may help demonstrate differences between opinion and fact. Student mastery of learning objectives such as those above may be evaluated by short-answer or multiple-choice exam questions.

Objectives that promote development of professional attitudes and behaviors are not easily examined with multiple-choice questions but can be assessed through essay questions, faculty observation, and structured assessments with checklists of specific knowledge, attitudes, or behaviors [3]. Group discussions or written assignments may generate self reflection through objectives such as "Identify your own biases and explore how these may impact on your professional relationships" or "Reflect on and describe how your verbal communication may generate misunderstanding". All objectives must be carefully edited to maximize precision and compatibility with course goals and exams.

Topics in professionalism

Professionalism topics range from etiquette to controversy about the use of enhancement drugs or stem cell research. In

choosing a topic, scientists guided by professional passions and concerns will teach the associated information more enthusiastically and knowledgably. Excitement about a particular disease or scientific development can be spun into a learning objective. "Identify the pros and cons of screening for diabetes" may reinforce scientific and clinical material relevant to diabetes while simultaneously demonstrating the need for critical thinking about prevention, cost effectiveness, and public health.

Critical thinking is essential to professionalism but is often displaced by emphasis on textbooks and dogma. Objectives may generate critical thinking about dogma while reinforcing scientific content: "List three socioeconomic considerations that bear on access to care"; "Evaluate credibility of three websites about Alzheimer's disease"; or "Describe a rationale that justifies screening for retinitis pigmentosa" (other conditions may substitute). This last objective points to ethical questions regarding testing for conditions with limited or no treatment.

When professionalism is integrated into a basic science course, students gain opportunities to develop integrative competencies and understand interconnections between science, medicine, research, health, healthcare, and policy. Nutrition courses might integrate professionalism with scientific content on obesity, malnutrition, or food security. Professionalism involves use of statistics and mathematical modeling to guide research questions and priorities. Documented cases about whistle blowers or conflicts of interest highlight the need for integrity, accountability, and professionalism in science and medicine.

Research scientists might introduce students to protections for animal or human research subjects, historic cases that bear on current guidelines, or publicly available material on the responsible conduct of research [4]. Introducing local or international guidelines elucidates expectations of professionals in science and/or medicine. These apply to research ranging from evolution to vaccine trials to use of stored tissue samples.

Teaching about guidelines for authorship promotes professionalism and ensures that students learn to cite references accurately in written or verbal communications. Many students do not know how to use references, interpret data, or that conflicting data may appear in reliable journals. Many erroneously believe that information found in PubMed, EBSCOhost, or even Google, is always accurate and reliable.

A range of real and perceived conflicts of interest (COIs) arise in science. Scientists compete for publications, grants, patents, and tenure. Scientists are susceptible to self interest and COIs that impact upon professional perceptions, priorities, and objectivity [5]. Professionalism helps scientists and doctors recognize, guard against, and manage COIs. Teaching students about COIs helps maintain integrity and reliability.

Educational methods

Adopting learning objectives enables professionalism to be incorporated into science courses. These may be fulfilled through cases, readings, service projects, lectures, labs, group discussions, or written work. Community service projects encourage social responsibility by exposing students to unique perspectives and needs, and providing insight into influences on health and healthcare. Science labs may teach science, team work, and professional communication. Computer labs and database searches can demonstrate how to access valid and reliable information. Any educational method can link a professionalism objective to an existing course component, and questions can be designed to assess student mastery. An electronic monthly medical student journal on professionalism offers topics and resources for students and faculties interested in professionalism [6].

Role modeling can be a useful means of teaching professionalism if reinforced by student reflection on the behaviors demonstrated [7]. Lectures transmit large amounts of information and may simultaneously demonstrate attitudes, behaviors, or critical thought. A powerpoint slide might highlight professional competencies or guidelines. Relevant websites might be listed on a slide or even linked live during a lecture. Lectures may prompt didactic interactions about uncertainties regarding diagnosis, treatment, or scientific or clinical evidence. Role play, panel discussion, or debate demonstrates disagreements while modeling professional attitudes in lectures or group discussions.

Group discussions often use case vignettes or discussion questions that help students define their professional identities by reflecting on professional competencies, medical mistakes, COIs, cheating, alcohol abuse, what constitutes professional dress, or how students present themselves on social networking sites. Groups in my course last 90 minutes and address four topics or cases, with up to five questions for each. Effective groups require faculty facilitators who understand the learning objectives and create a learning environment in which students speak openly and do most of the speaking.

Questions to elicit reflection include "What professional virtues would you like your own doctors to have, and how do these develop"; "How often do doctors make mistakes and with what repercussions"; "How might you know whether your classmate has an alcohol and/or substance abuse problem, and when to intervene"; or "How does socioeconomic background influence one's expectations of medicine". Such questions generate reflection and communication about values and professional identity.

Managing uncertainty: Climate change as an example

Science provides objective information but raises moral issues. Helping students to explore questions about when life begins, and how human moral status may differ at different stages of life or from that of animals mandates their consideration of the moral implications. Many scientists have a sense of social responsibility and some nurture this in their students. To do this, I use a case about Amanda, an Olympic athlete who performed well in China but saw the team physician there for coughing and respiratory symptoms. After returning home, Amanda developed a chronic respiratory problem and visited the team physician to discuss the possible impacts on her health and athletic ambitions. This case develops curiosity, objectivity, social

responsibility, and moral reasoning. Moral reasoning may be taught through scientific case scenarios that promote professionalism [8].

Using questions that teach moral reasoning in science [8], my students analyze this case in lecture and groups. They consider who has a legitimate interest in Amanda's care (among others these include Amanda, her doctor, her teammates, other athletes and teams, people with chronic respiratory problems, and the Olympic Committee). They consider what actions the team doctor might take (they are instructed to identify two actions at either extreme of those possible and another in between). Typical responses are to dismiss Amanda's concern or offer empty reassurances; acknowledge scientific uncertainty about the impact of air quality on an athletic career; or seek more information about the health effects of air quality or climate change on health. Seeking more information might mean accessing literature about health and air quality; asking other athletes about similar symptoms and experiences; or asking other doctors about health effects on their athletic patients.

For each action raised, students discuss probable outcomes and severities, explore the doctor's duties to Amanda and other stakeholders, and identify other moral concerns in the case. Students learn moral reasoning while developing insights into societal and political influences on science and/or medicine, professional duties, and their own limited knowledge. Any case may be analyzed but this one addresses scientific and clinical uncertainty about the health impacts of climate change.

Population is rising globally [9], generating increased use of energy, land, water, and food. To meet the growing needs even in poor nations, annual global livestock production is expected to double by 2050 to 465 million tons of meat and over 1000 million tons of milk [10]. Livestock production and other agricultural practices generate over 20% of global greenhouse gases (GHGs), which directly and indirectly impact on health and environment [10,11]. GHGs reduce agricultural productivity and food security but agricultural activities increase GHGs, so reciprocal affects complicate our understanding [11,12]. Health impacts of GHGs include altered patterns of infectious disease [10,13] and drought associated with hunger, malnutrition, and diarrheal disease [11,12]. The impacts of GHGs on temperatures, rainfall, and seasonal pests are such that by 2050, wheat and rice yields in poor nations will decline causing global prices for grain to increase by over 170% [14].

When faced with such health threats, society trusts that scientists and physicians will predict, acknowledge, and respond effectively. The precautionary principle requires professionals to protect patients and society from severe or widespread threats even when evidence about cause and effect is inconclusive. Upholding the trust of society may involve documenting or drawing awareness to a problem, or supporting efforts to design and sustainably implement effective protective measures. One protective measure against GHGs is to increase global availability of condoms because this would inexpensively reduce population growth and GHGs [15]. Scientists and physicians have a professional responsibility to mitigate climate change [16,17] and may fulfill this by teaching professional responses to the problem.

Conclusions

Scientists can teach professionalism by incorporating related learning objectives into their courses. They have the knowledge and experience to develop goals, objectives, and topics that link professionalism with their own disciplines and courses. Their expertise equips them to identify teaching methods suitable to their institutions, courses, and students, and to design and administer assessments of student mastery of professionalism objectives.

Professionalism is part of bioethics, medicine, and science. It encompasses concerns ranging from etiquette to societal duties. Teaching uncertainty about the health impacts of climate change or any scientific topic will help students learn to manage uncertainty and reason objectively. Scientists' duties to society encompass the teaching of professionalism, which enables students to reflect on their professional attitudes, values, and competencies, and on professional standards and ethical codes.

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